IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Brad A. Armstrong	Docket No.:	F2811
Serial No.:	10/773,025	Art Unit:	2629
Filed:	February 4, 2004	Examiner:	William Boddie
For:	Image Controller		

DECLARATION OF BRENT GILLESPIE, Ph.D.
SUBMITTED UNDER 37 C.F.R. § 1.132

1. My name is Brent Gillespie, I am over 21 years of age, and make this declaration based upon my own personal knowledge. All of the statements contained herein are, in all things, true and correct.

Background and Qualifications

2. Since 1999, I have been a faculty member in Mechanical Engineering at the University of Michigan. I have been an assistant professor since 1999 and an associate professor since 2007.

3. I received my Bachelors degree in Mechanical Engineering from the University of California, Davis in1986 and my Masters and PhD in Mechanical Engineering from Stanford University in 1992 and 1996, respectively. I have been employed at Hewlett Packard Corporation (1986-1990), Immersion Corporation (Summers 1994 and 1995), and Interval Research Corporation (1994) and I have consulted for Immersion Corporation (1996-2000). I held a Postdoctoral Fellowship in the Laboratory for Intelligent Machines at Northwestern University from 1996-1999.

4. My training and research has been in the areas of haptic interface, rehabilitation robotics, and human motor behavior. I have developed applications in virtual reality, rehabilitation, automotive interface, human-computer interface, and electronic musical instruments. In the area of haptic interface, I have published papers on device design (including designs that employ compliant mechanisms), haptic rendering algorithms, and control analysis. At the

University of Michigan, I teach courses in system dynamics, computational dynamics, control, mechatronics, and robotics.

5. I received the Presidential Career Award for Scientists and Engineers in 2001 and I have participated in workshops sponsored by the National Academies of Engineering in smart prosthetics and frontiers of engineering. I have been named on three patents assigned to Immersion Corporation: US Patents 5,721,566; 6,486,872; and 6,271,828, issued February 24, 1998; November 26, 2002; and August 7, 2001, respectively.

Retention as Expert Witness

6. I have been retained by Anascape, Ltd. to review documents associated with the United States Patent and Trademark Office's ("USPTO") examination of U.S. Patent Application serial no. 10/773,025 ("the '025 Application"). I understand that Anascape, Ltd. is the assignee of the '025 Application. More specifically, I have been retained to identify and present rebuttal evidence in response to the USPTO's rejection of the pending claims as set forth in the Office Action dated May 19, 2009.

7. I am being compensated at my standard hourly consulting rate for my work on this project. My compensation and the terms of retention as an expert witness are not contingent upon the nature of my findings or the outcome of any matters at issue in the '025 Application or any other Anascape, Ltd. patent application. Prior to my retention for this project, I previously prepared a Declaration in Anascape, Ltd.'s pending patent application no. 11/150,412.

8. While preparing this Declaration, I have worked with Michael Fogarty, Anascape Ltd.'s attorney. Mr. Fogarty provided copies of the following documents for me to review:

- Patent application publication US 2004/0160414 A1, which includes the specification and drawings of the '025 Application as filed;
- The claims of the '025 Application as pending following the Supplemental Amendment filed on February 27, 2009;
- USPTO Office Action for the '025 Application dated May 19, 2009;

- U.S. Patent No. 4,493,219 to Sharp;
- U.S. Patent No. 5,298,919 to Chang;
- U.S. Patent No. 5,589,893 to Gaughan; and
- U.S. Patent No. 5,724,106 to Autry.

Application Serial No. 10/773,025

9. I have read the disclosure of the '412 Application and reviewed the accompanying drawings.

10. I understand that the '025 Application is a continuation-in-part of U.S. Patent Application serial no. 09/893,292, which was filed on June 26, 2001 and issued as U.S. Patent No. 7,345,670; that Application serial no. 09/893,292 is a continuation of U.S. Patent Application serial no. 09/721,090, which was filed on November 21, 2000 and issued as U.S. Patent No. 6,310,606; and that Application serial no. 09/721,090 is a continuation of U.S. Patent Application serial no. 08/677,378, which was filed on July 5, 1996 and issued as U.S. Patent No. 6,222,525. Accordingly, I understand the priority date for the '025 Application to be July 5, 1996.

11. I understand that the claims pending in the '025 Application will be amended as indicated below. Therefore, I have based my analysis on the below-listed claims.

> 1-8. (Canceled)
>
> 9. (Currently Amended) An image controller allowing control of an image generation device capable of creating three-dimensional imagery, the image controller comprising:
> a single input member capable of being manipulated in six degrees of freedom by a human hand <u>to control movement of the three-dimensional imagery in six degrees of freedom</u>;
> a circuit board having an upper surface and a lower surface;
> a first proportional sensor located on the upper surface of the circuit board, the first proportional sensor indicates manipulation of the single input member;
> a secondary input member capable of being controlled by the human hand to effect bidirectional movement <u>of the three-dimensional imagery</u> on at least

one axis <u>independent of the control of three-dimensional imagery by the single input member</u>;

two additional sensors located on the upper surface of the circuit board, the two additional sensors indicate the bidirectional movement of the secondary input member;

one additional sensor located on the lower surface of the circuit board;

a second proportional sensor indicating rotation of the single input member;

two button sensors located on the upper surface of the circuit board control at least a volume function;

one button sensor located on the upper surface of the circuit board controls an ON/OFF function;

a transmitter allowing wireless communication of information from the controller to the image generation device, the information is useful to control the image generation device; and

a battery compartment adapted to hold a battery for powering the image controller.

10. (Previously Presented) The image controller of claim 9, wherein said first proportional sensor is of a capacitive type.

11. (Previously Presented) The image controller of claim 9, further comprising:

two button sensors located on the upper surface of the circuit board control channel switching.

12. (Currently Amended) An image controller allowing control of an image generation device capable of creating three-dimensional imagery, the image controller comprising:

a single input member capable of being manipulated in six degrees of freedom by a human hand <u>to control movement of the three-dimensional imagery in six degrees of freedom</u>;

a circuit board;

a first proportional sensor located on the circuit board, the first proportional sensor indicates manipulation of the single input member;

a secondary input member capable of being controlled by the human hand to effect bidirectional movement <u>of the three-dimensional imagery</u> on at least one axis <u>independent of the control of three-dimensional imagery by the single input member</u>;

two additional sensors located on the circuit board, the two additional sensors indicate the bidirectional movement of the secondary input member;

two button sensors located on the circuit board control at least a volume function;

one button sensor located on the circuit board controls an ON/OFF function;

a transmitter allowing wireless communication of information from the controller to the image generation device, the information is useful to control the image generation device; and

a battery compartment adapted to hold a battery for powering the image controller.

13. (Previously Presented) The image controller of claim 12, wherein said first proportional sensor is of a capacitive type.

14. (Previously Presented) The image controller of claim 12, further comprising:

two button sensors located on the circuit board control channel switching.

15. (Previously Presented) The image controller of claim 13, further comprising:

a second proportional sensor indicating rotation of the single input member.

Level of Ordinary Skill in the Art

12. It is my opinion that the relevant art is in the combined fields of electrical engineering, mechanical engineering, and user interface design, otherwise known as "haptic device engineering" or "physical human-robot interaction." It is my opinion that a person of ordinary skill in this area would normally have a Master's degree in bioengineering, electrical engineering, or mechanical engineering. Alternatively a Bachelor's degree in electrical engineering, mechanical engineering or bioengineering with significant job experience in haptic interface design, haptic device engineering or physical human-robot interaction.

Analysis of May 19, 2009 Office Action

13. I have reviewed and analyzed the USPTO Office Action dated May 19, 2009 ("Office Action") and the references cited therein (Sharp, Chang, Gaughan, Autry). The following is an analysis of the claim rejections detailed starting on page 2 of the Office Action. The Office Action rejects pending claims 9-15 over a combination of the Sharp, Chang, Gaughan, and Autry references.

14. The disclosure of Chang, even when taken in conjunction with the disclosure of Gaughan, Sharp, and Autry, does not teach the invention that is disclosed and claimed in the '025

application. The '025 application discloses an embodiment in which the "input member" is represented in a single rigid body (element 12, the movable sphere). The motions of this body relative to the reference member (element 18, the housing) may be transduced by appropriate displacement or motion sensors. Alternatively, or in a complimentary fashion, the interaction forces between elements 12 and 18 may be transduced by appropriate force sensors. The transducers are arranged to sense all 6 axes of motion or force (i.e. 3 translations and 3 rotations of a single rigid body in three-dimensional space or 6 degrees of freedom). This embodiment is recited in the claims as a "single input member."

15. The embodiment of the single input member in a single rigid body has special pertinence to the usability of the device by a human user. Motion in six degrees of freedom is accessible to a human user through the manipulation of a single input member. The relationship of the available behaviors in each of the 6 degrees of freedom is apparent to the user by virtue of their embodiment in a single rigid body. Essentially the expectations of a user with regard to the available behaviors of each axis are set up through previous experience with single rigid bodies (any object held in the hand such as a sphere or a hammer) and that previous experience plays a significant role in the usability of the device. Learning and ultimate ease of use is governed by what a user can recognize and how he or she can apply previous experience and motor programs when using the device. A user will know how to manipulate multiple axes simultaneously by pushing on the sphere through certain contacts (between a finger or set of fingers and sphere) in certain directions. Expectations formed based on previous experience with similar objects whose motion is constrained in similar ways are met in the available behaviors of the device. Thus all six degrees of freedom may be manipulated by the user in intuitive ways.

16. Chang does not disclose a single input member. When the input member is embodied in more than one rigid body - as is the case in the Chang reference - then the behaviors of the various degrees of freedom are related to one another in very different ways. The Office Action identifies Chang as having five degrees of freedom. In the Chang reference, the input member is embodied in two rigid bodies to provide these five degrees of freedom. Ball 22 (the mouseball) is capable of being manipulated in 2 axes (by manipulating body 10 of the

mouse in two directions on the table) while sphere 32 (the trackball) is capable of being manipulated in 3 axes (by manipulating body 32 relative to the mouse housing 10). Essentially the Chang "input member" is a configuration of multiple rigid bodies (32 and 22). The available behaviors of the input member under manipulation by a human user are affected by that arrangement or configuration. The Chang input member (or mouse 10) requires multiple inputs to provide the five degrees of freedom listed in the Office Action.

17. The usability of the Chang device is governed by the similarity of the set of available behaviors to previous experience. For the user, manipulating the trackball 32 is performed by imposing relative motions between 32 and 10 while manipulating the mouseball 22 is performed by imposing relative motions between housing 10 and the table upon which the mouse rests. Both bodies 32 and 10 are grasped and manipulated relative to one another or relative to a third member (the table top) by the user in the Chang invention. The available behaviors (and associated expectations based on previous experience) are dictated by this configuration. In the device discussed and claimed in the '025 application, the single input member (for example, sphere 12) is manipulated relative to a reference member and no third body is involved.

18. One might suppose that the force applied or motions imposed by a human user to the Chang trackball sphere 32 alone (without grasping the mouse housing 10) are transmitted through the body of the mouse (body 10) and through the encased mouseball 22 to the table top (mechanical ground) and thus the user need not grasp the housing 10. Though such practice by a user would be unconventional it is certainly possible. However, the behavior of the device, or the resulting motion of the trackball 32, housing 10, and mouseball 22 is very different than the behavior of a single rigid body whose force/motion relative to a single reference member are measured by sensors.

19. One of ordinary skill in the art, having read the Chang disclosure, would not consider the use or operation of trackball 32 without considering the corresponding effects on mouseball 22. In particular, pushing sideways (parallel to the tabletop) through a contact on the very top of trackball 32 will produce angular rotation of 22 about an axis parallel to the tabletop and

potentially (depending on the friction and inertia forces) translational motion of 10 in a direction parallel to the tabletop - but perpendicular to the axis of rotation of 22. That translational motion is not restricted in magnitude and will couple to the rotational motion of 22.

20. An important feature made available in the device described and claimed in the '025 application is the capability of manipulation of all six degrees of freedom while operating as a hand-held device. This is made possible by virtue of embodying the input member in a single rigid body, which may be held in the hand without compromising the manipulability of the single input member. Simultaneous and intuitive manipulation of the two rigid bodies in the Chang device (bodies 22 and 32) is not possible when holding the housing 10 in the hand. The tabletop is necessary for intuitive manipulation of the degrees of freedom in the Chang invention.

21. The addition of a sixth degree of freedom to the Chang invention through the combination with the Gaughan invention must be considered carefully for its effect on the set of behaviors made available to the user, and by implication, for its effect on the usability of the device. The sensor 44a of the Gaughan device that detects motion of trackball 42 relative to housing 70/71 is configured as a force sensor (since the motion of trackball 42 is limited, or spring-loaded). In this regard, the Gaughan sensor for translational force/motion is quite analogous to those used for translational force/motion in the Armstrong device. The combination, however, of a force sensor in one of the translational axes (degrees of freedom) with the translational motion sensors associated with the mouseball in the other two translational degrees of freedom in the Change device presents a set of available motions to the user that is very different than those in the claimed device. The coupling of rotational and translational degrees of freedom is mixed between force (with limited range of motion) and motion (with unlimited range of motion) in the combination device of Chang and Gaughan. The user must accommodate the available behaviors in very different ways, and such a mix of translational sensors will produce a non-intuitive user interface.

22. Additionally, Chang's mouse 10 already has a third input member (thumbwheel 26) for providing a sixth degree of freedom input. The Chang reference describes thumbwheel 26 as providing a third translational input with respect to the Z-axis. Because the Chang mouse already includes a Z-axis input, there would be no reason for one of ordinary skill in the art to combine Chang with Gaughan to add another Z-axis input.

23. The pending claims further require "a secondary input member capable of being controlled by the human hand to effect bidirectional movement of the three-dimensional imagery on at least one axis independent of the control of three-dimensional imagery by the single input member." The Office Action identifies the ball 22 on the Chang mouse as the secondary input member. However, the Office Action also describes mouse 10 as moving in two degrees on the table on which it rests. Ball 22 is required to generate inputs in the lateral X-Y direction when mouse 10 is moved on the table in this situation. Ball 22 and ball 32 combined provide the five degrees of freedom identified by the Office Action for mouse 10. Accordingly, ball 22 is not available as a secondary input member, but is part of the multiple-input mouse 10.

24. In summary, it is my opinion that one of ordinary skill in the art would not consider the Chang mouse 10 to be a single input member having 6 degrees of freedom. Instead, Chang teaches a multiple-input in which trackball 32, mouseball 22, and thumbwheel 26 are used to generate 6 degree of freedom inputs. One of ordinary skill in the art would also recognize that mouseball 22 is used to provide lateral input for X-Y motion of the mouse 10 and is not a secondary input member used to provide inputs for an additional axis.

25. Additionally, it is my opinion that one of ordinary skill in the art would not combine the references as suggested in the Office Action. Because the Chang mouse 10 already has a Z-axis input using thumbwheel 26, there is no reason to combine the Chang mouse with the Gaughan switch 44 to add an additional Z-axis input. Thumbwheel 26 is a third input member used to provide the sixth degree of freedom for mouse 10.

DECLARATION

I, Brent Gillespie, declare under penalty of perjury under the laws of the United States of America that the foregoing declaration is true and correct.

Executed on the 19 day of November, 2009 in Washtenaw county, Michigan.

BRENT GILLESPIE, Ph.D.